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15

ON *HETEROSUCHUS VALDENSIS* FROM
THE HASTINGS SAND.

On HETEROSUCHUS VALDENSIS, Seeley, a PROCELIAN CROCODILE from the HASTINGS SAND of HASTINGS. By H. G. SEELEY, F.R.S., F.G.S., Professor of Geography in King's College, London.

[PLATE XII.]

THE specimen in the British Museum, numbered 36555, came there in the second Mantellian collection, which was acquired after Dr. Mantell's death. It is part of a thin ironstone nodule, 10 centim. long and 6 centim. wide, from the Hastings Sand of Hastings, manifestly water-worn, but containing vertebræ which have not hitherto been determined. The nodule (Pl. XII. fig. 7) displays the remains of fully a dozen vertebræ, which extend round the nodule in parts of more than one coil, so arranged as to expose the ventral surface or bodies of the vertebræ, towards the external margin of the concretion. These vertebræ indicate a procelian Crocodile of small size; and although the remains are so imperfect, I refer them to a new genus, since their forms are different from those of any Purbeck Crocodiles or other described Crocodilia.

The nodule displays some other vertebrate remains which may possibly belong to another kind of animal. Thus in a transverse fracture the outlines may be traced of two long ovals which extend in the same axis, and may represent the superior aspect of the parietal region of a small skull, in which each temporal fossa is 13 or 14 millim. wide and 7 millim. long. The external surface appears to show a very fine punctate ornament, not unlike that seen in some small Purbeck Crocodiles; and what might be the quadrate bone is seen to extend in an outward direction as it is prolonged distally. No procelian Crocodile has the temporal vacuities elongated in this way; but from the imperfect preservation and small size I am doubtful whether the skull should be referred to the same animal as the vertebræ, on the hypothesis that it is to be included in the Procelia.

On the worn external surface of the nodule, somewhat below the remains of the sacrum, are some obscure outlines of bones, which can only be followed with difficulty, but which may be pubis and ischium; and in the position in which the acetabulum might exist, there is a well-defined hemispherical pit. These bones are much smaller than would have been expected; but their proximity to the sacral vertebra makes it important to remark that the acetabulum is that of a lacertilian, while the forms of the bones which combine to form it are not crocodilian. In the possibility that all the remains may be portions of one animal, this fossil would diverge from existing Crocodiles in a direction of which no crocodilian has hitherto given evidence.

The vertebræ include one late cervical, eight dorsals, and two which may be classed as sacral. These vertebræ are remarkable

for a completeness of ossification which existing Crocodiles do not show. I have no doubt that the specimen was mature, on account of the length of the neural spines (fig. 7, *ns*). All traces of sutures are obliterated, and there is no trace of the inflation which, in living Crocodiles, commonly marks the line of the neuro-central suture. The articular ball of the centrum was as well ossified as in a lizard or serpent (figs. 7, 8), and the ridges on the upper part of the neural arch are defined with a sharpness unknown among living Crocodiles, and suggestively Dinosaurian. The most distinctive features, however, of these vertebræ are, the side-to-side compression of the bodies of the centra, and the comparatively depressed neural arch, with its strong zygapophysial ridges and well-developed neural spine. The inferior V-shaped approximation of the sides of the centrum, which throws the neural arch out laterally above, is the principal generic character seen in the dorsal region. The cervical vertebræ are so imperfectly exposed that it is difficult to draw generic characters from them; but if the one specimen seen is rightly determined, it shows a fundamental difference from procœlian Crocodiles in the elevation of the facet for the rib upon the neural arch to a position which almost adjoins the prezygapophysis. But as these vertebræ are not continuous with the dorsal series, and there is no diapophysial tubercle on the neural arch, I hesitate to draw what would otherwise be a legitimate conclusion as to affinities from this character.

Two or three cervical vertebræ are present, but only one is partially free from the matrix. The second specimen shows the outline of the neural arch from above; but the neural spines, which had the usual anterior position, are not preserved. The measurement is 24 millim. from the prezygapophysis to the postzygapophysis, and about 17 millim. from side to side over the zygapophysial facets, while the least side-to-side measurement in the median constriction is 8 millim. The one vertebra which is partly free, though badly preserved, shows the neural arch to have been greatly depressed, so that the height from the base of the centrum to the zygapophysis is about 15 millim., and this is apparently also about the length of the centrum. The left side of the centrum is subquadrate and concave, with a small circular facet for the diapophysis external to and impressed immediately below and behind the prezygapophysial facet. There is no trace of a tubercle, such as is seen in Crocodiles; though the parapophysis has the usual oblong form, compressed from above downward, and, though quite on the base of the side of the centrum, is further distant from its anterior border than in existing Crocodiles. The under surface of the centrum is too imperfectly preserved to indicate whether a hypapophysis was developed; but the emargination of the undersides of the bases of the parapophysial tubercles defines a constricted base to the centrum which is not seen in existing Crocodiles.

Seven dorsal vertebræ extend in continuous sequence, and their centra appear to increase slightly in length as they extend backward. All are marked by the obliquity of the cup and ball, which is rather more pronounced than in existing Crocodiles; but as the

inferior margin of the eup is in every case worn, the obliquity appears greater than it was in life. Each centrum is about 19 millim. long; the articular ball is well rounded. The form of the centrum is compressed from side to side below, with the base rounded. The sides are concave, without any thickening of the bone in the position where the neurocentral suture is usually present. The transverse processes are broken, but enough remains to show that the usual posterior concave incision existed between the transverse process and the postzygapophysis. From the hinder margin of the transverse process a sharp ridge descends in a concave curve as it extends backward to the outer border of the articular ball. Posterior to this ridge the bone of the neural arch is impressed, and ascends to the postzygapophysis. The underside of the transverse process (fig. 8, *t*) which was compressed from above downward in the usual way, appears to have been convex at its base. From both the anterior and posterior zygapophyses well-defined compressed rounded ridges ascend and converge, as they extend inward towards the neural spine. Between these ridges is a concave recess with a flat base, forming the inward termination of the upperside of the transverse process. The height from the base of the centrum to the transverse process is greater in the anterior vertebræ of the series than in the later ones. In the third it is 15 millim.; towards the end it is scarcely more than a centimetre. The neural spines are well developed; they ascend vertically in the anterior vertebræ and are inclined slightly forward in the later ones. The height from the base of the centrum to the summit of the neural spine is about 33 millim. The spine widens a little towards its summit, which is convex from front to back; its anterior and posterior margins are slightly concave.

A lumbar centrum is present, and exhibits a rather narrow neural canal.

The sacral vertebræ are imperfectly preserved; there were probably two. From the second the transverse processes are completely lost, but the first shows these processes to have been quadrate and strong. As in existing Crocodiles, they are concave in front, flattened above, and, as they extend outward, depressed below the prezygapophyses. The transverse measurement across the processes, as preserved, is 25 millim.

The vertebral characters described show divergences from existing Crocodilia, such as on the whole are approximations towards Dinosaurian types of Wealden age, a condition of more interest from the Crocodiles of the Gosau beds having shown some approximations in vertebral characters to the Gosau Dinosaurs.

A few isolated vertebræ of similar character were collected by Dr. Mantell, from Tilgate, and from Brook in the Isle of Wight. A small caudal vertebra from Tilgate has the base of the centrum compressed from side to side and rounded, with a concave impression above the middle of the side, immediately beneath the transverse process. The prezygapophysis is long and directed upward and outward. The articular eup is perfectly circular. The centrum is

13 millim. long. Another Tilgate caudal vertebra, later in the series, is about 15 millim. long. It possessed the transverse process and well-developed procœlian articulation; but the neural arch is greatly shortened and limited to the middle of the centrum, as in some Dinosaurs. The procœlian vertebræ of similar size are from Brook. The specimen 36524, however, has the centrum as well rounded from side to side as in existing Crocodiles, and is not referable to this genus.

It may be interesting to remark that although this is the oldest procœlian Crocodile hitherto described, the British Museum contains a single cervical vertebra, no. 48244, from the Purbeck beds, which has a well-defined procœlian cup, and the cervical neural arch is constructed on the usual crocodilian plan.

The existence of this form of vertebra in the Purbeck beds accentuates the apparent difference of the cervical articulation for the rib in the Wealden specimen, a difference sufficiently remarkable to make more striking modifications of the skull and pelvis not impossible.

I am indebted to Dr. Henry Woodward, F.R.S., for the facilities afforded me in studying and describing this specimen.

EXPLANATION OF FIGURES.

PLATE XII.

ns, neural spine; *t*, transverse process.

Fig. 7. Slab, showing sequence of dorsal vertebræ of *Heterosuchus valdensis*, Seeley.

8. View of the same slab, showing the underside of the centruns of the dorsal vertebræ.

